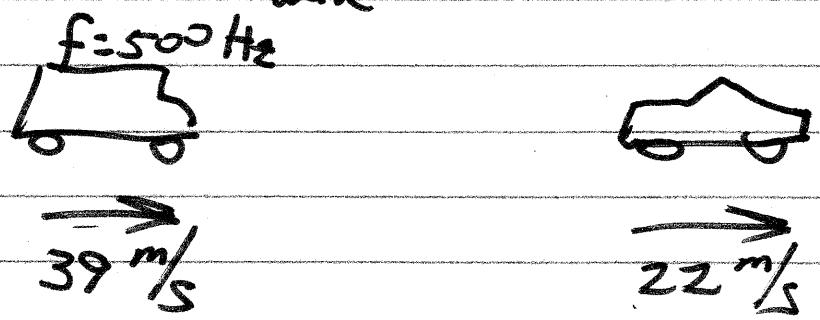
① Phys 2426 2014-11-17

Optics - Controlling Waves
- What do waves normally do?
- How can we use wavelength?
- How can we use the speed?

But First: HW 5 Q's?

#13 Doppler of ambulance siren.

$$\frac{\Delta f}{f} = \frac{v_{rel}}{v_{wave}} \qquad v_{rel} = v_2 - v_1$$



$$v_{rel} = 17\ m/s$$

$$\frac{\Delta f}{500\ Hz} = \frac{17\ m/s}{340\ m/s} = 0.05$$

$$\Delta f = (0.05)(500\ Hz) = 25\ Hz$$

Approach: $f + \Delta f = 525\ Hz$

Leaving: $f - \Delta f = 475\ Hz$

#12: Intensity $\propto 1/r^2$

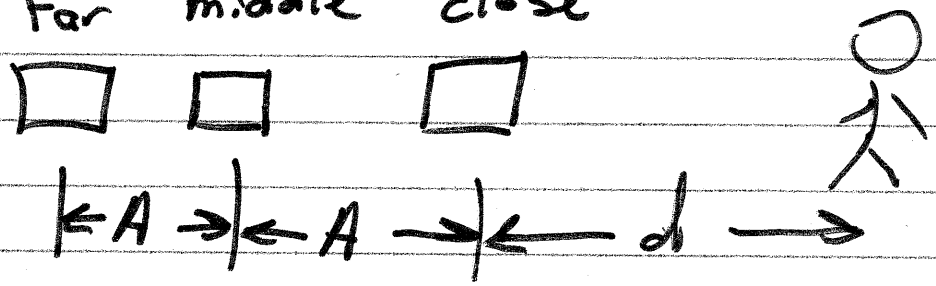
	Initial	Final	Change
SoundLevel	131 dB	100 dB	−31 dB
Distance	7 m	$(35.5)(7) = 248$ m	$\sqrt{1259} = 35.5$
Intensity			$10^{3.1} = 1259$

#14

$$X = A\sin(2\pi f t)$$

Distance ranges from ~~(A+A) to (d-A)~~

For middle close

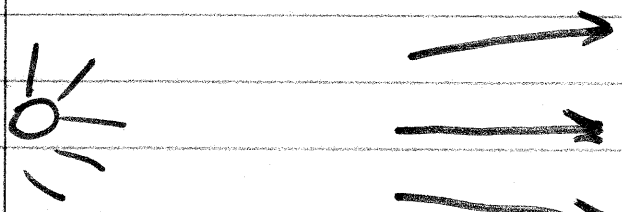


Distance affects intensity.

$$V = \underbrace{2\pi f A}_{\text{max } V}\cos(2\pi f t)$$

(3)

Normal Light Sources and Propagation



Point Source

Near

Rays are diverging

Far

Rays are parallel

LASER →

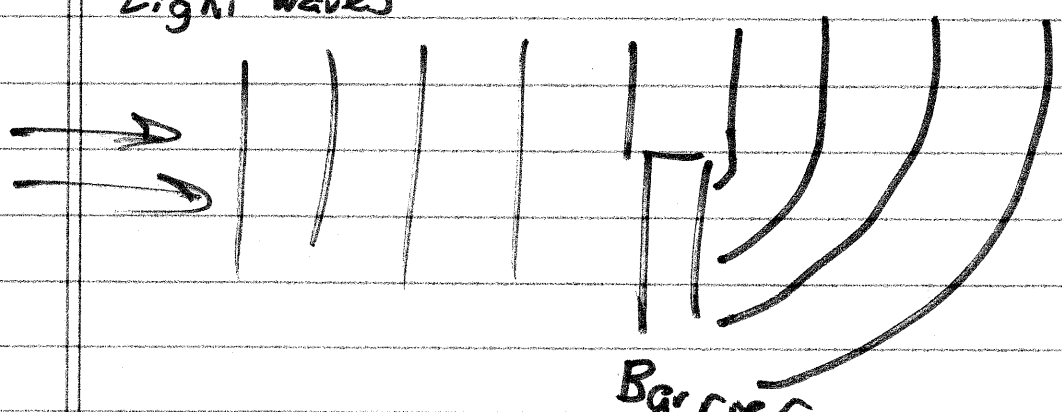
single, parallel group of rays

Ray - straight path of part of a field of light.

Exceptions:

- Diffraction
- Refraction
- Reflection

Diffraction - Bending of a wave as it passes a partial barrier.



The bending depends on the wavelength λ.
Longer λ → bends more
Shorter λ → straighter path

Ex: Radio vs. Light
$\lambda = 3$ m $\lambda \approx 500$ nm

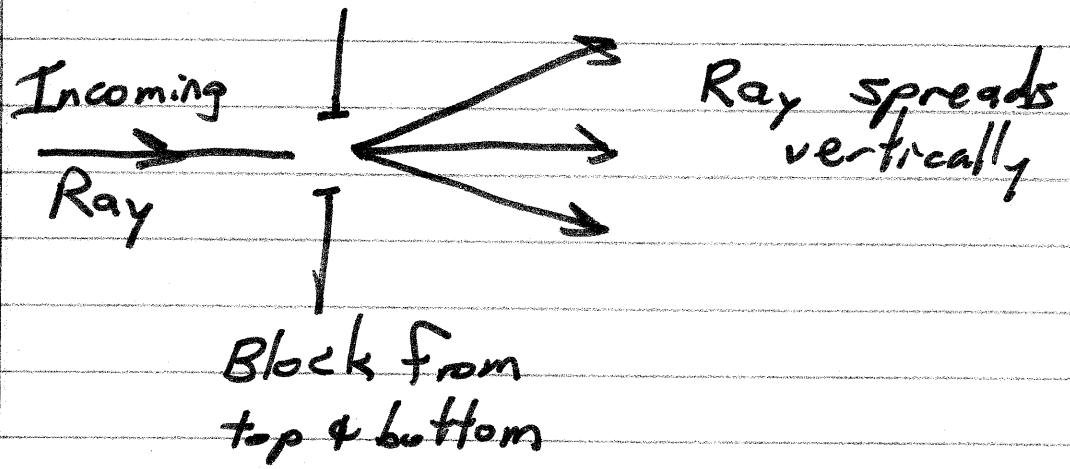
Analytical Cases:

Single-Slit: $m\lambda = a \sin\theta$

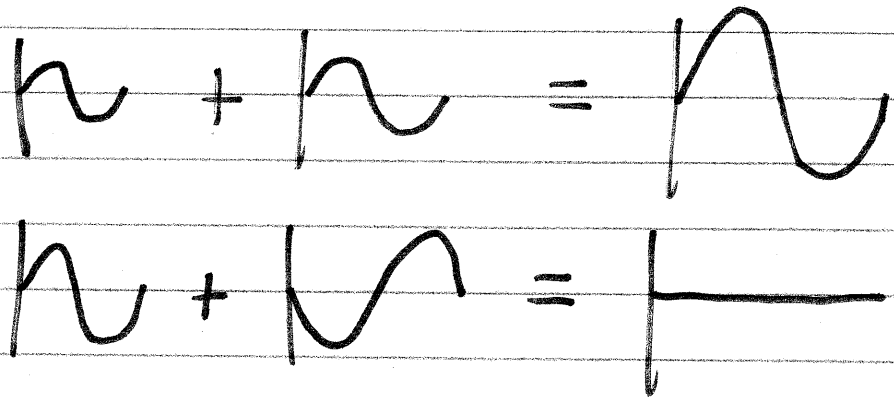
Two-Slit: $m\lambda = d \sin\theta$

Diffraction Grating:

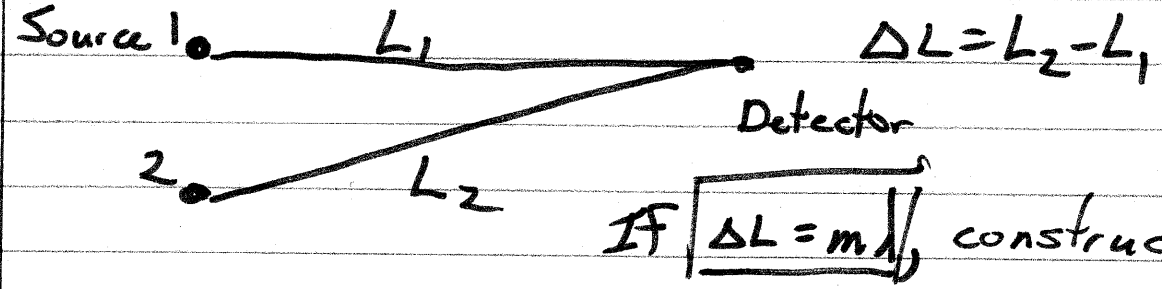
Single-Slit Diffraction:



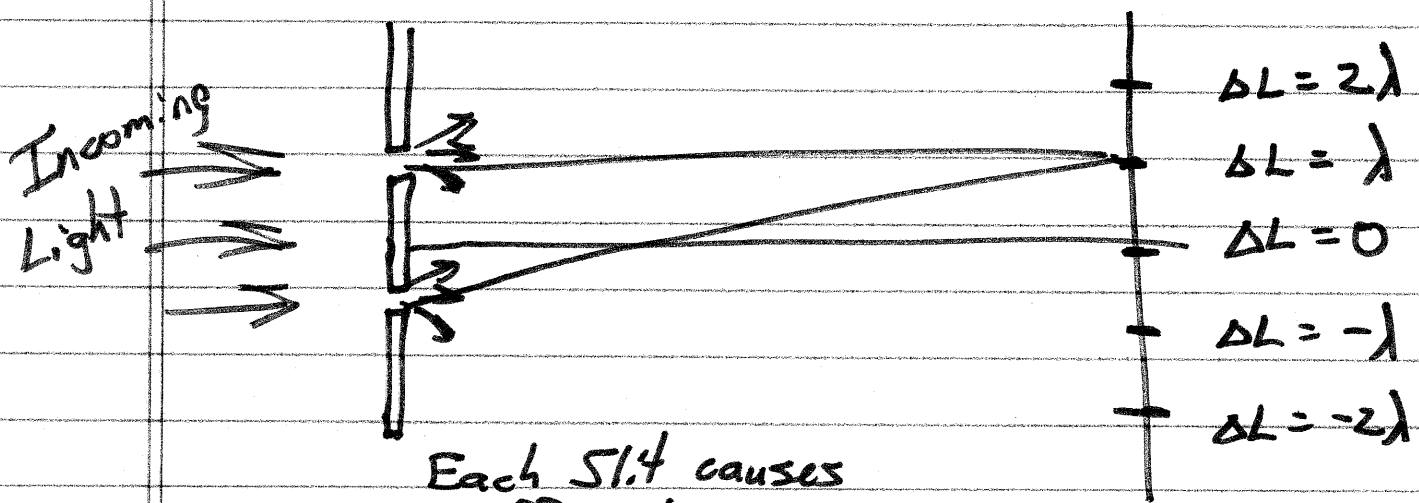
Interference - combining rays from different places makes the net amplitude depend on the phase difference.



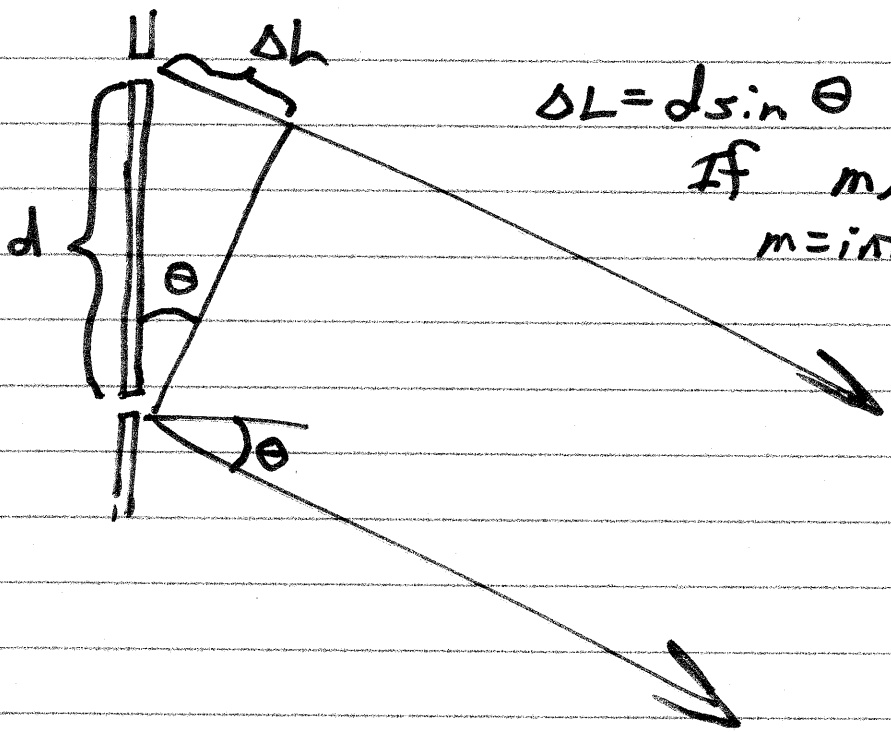
We control the phase by creating a path length difference.



Two-Slit Experiment:



If we zoom in on the two slits:



$\Delta L = d \sin\theta$

If $m\lambda = d\sin\theta$

m = int, bright.